XMM-Newton CCF Release Note

XMM-CCF-REL-274

OM Photometry. Time dependent sensitivity degradation correction: updating the coefficients

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May 12, 2011

1 CCF components

Name of CCF	VALDATE	List of Blocks changed	CAL VERSION	XSCS flag
OM_PHOTTONAT_0005	2000-01-01T00:00:00	DEGRADATION		No

2 Changes

The table extension "DEGRADATION" was introduced in 2006 to contain the coefficients of the time dependent sensitivity degradation correction. This correction is defined as

$$Correction\_factor = A + B \times MJD \tag{1}$$

$$Corrected\_rate = Measured\_rate \times Correction\_factor \tag{2}$$

Where MJD is the Modified Julian Date of observation and A and B depend of the filter. Their current values are given in Table 1.

Since time dependent sensitivity variation is due in part to sensitivity degradation of the photocathode, it is wavelength dependent and therefore it is different in each of the OM lenticular filters.

The correction is based in measurements of the count rates of three spectrophotometric standard stars, BPM 16274, HZ 2 and GD 153, which are observed regularly with OM in all filters. As more

Table 1: OM Time sensitivity degradation correction

filter	A	B	new A	new B
UVW2	- 2.72723	7.14543e-05	-1.1448062	4.2029730e-05
UVM2	- 2.91093	7.49769e-05	-1.1701736	4.2607553e-05
UVW1	- 1.16448	4.14899e-05	-0.30229645	2.5461415e-05
U	- 0.313603	2.51781e-05	0.19793896	1.5670360e-05
B	- 0.484320	2.84507e-05	0.14699201	1.6715890e-05
V	- 1.25429	4.32118e-05	-0.64141692	3.1820188e-05

data became available, we checked that the degradation had not deviated from its original values more than 1-2 %.

In the last evaluation, including data obtained in 2011, we see deviations from the original trend reaching as much as 5 % from the current values in the CCF for UVM2 filter, 4 % for UVW2, 3 % for UVW1 and 2 % for U, B and V.

Therefore we have updated the correction coefficients in this new version of the CCF. Table 1 gives both old and new coefficients.

3 Scientific Impact of this Update

The time dependent sensitivity degradation trend has changed with time. Therefore we need to update the coefficients to be able to obtain a proper correction.

In Figure 1 we can see the evolution of the count rates with time for the three observed stars. The current correction was based in data obtained before 2005, i.e. using less than half of the data points available now. The new fit (red dotted line) is therefore more precise.

4 Estimated Scientific Quality

The correction coefficients were thoroughly tested before releasing the SAS code that performs the correction. The time dependent sensitivity degradation is monitored regularly to ensure the repeatability and stability of all corrections applied by SAS when new observations and new versions of SAS become available (see test procedures and their results in the corresponding sections below).

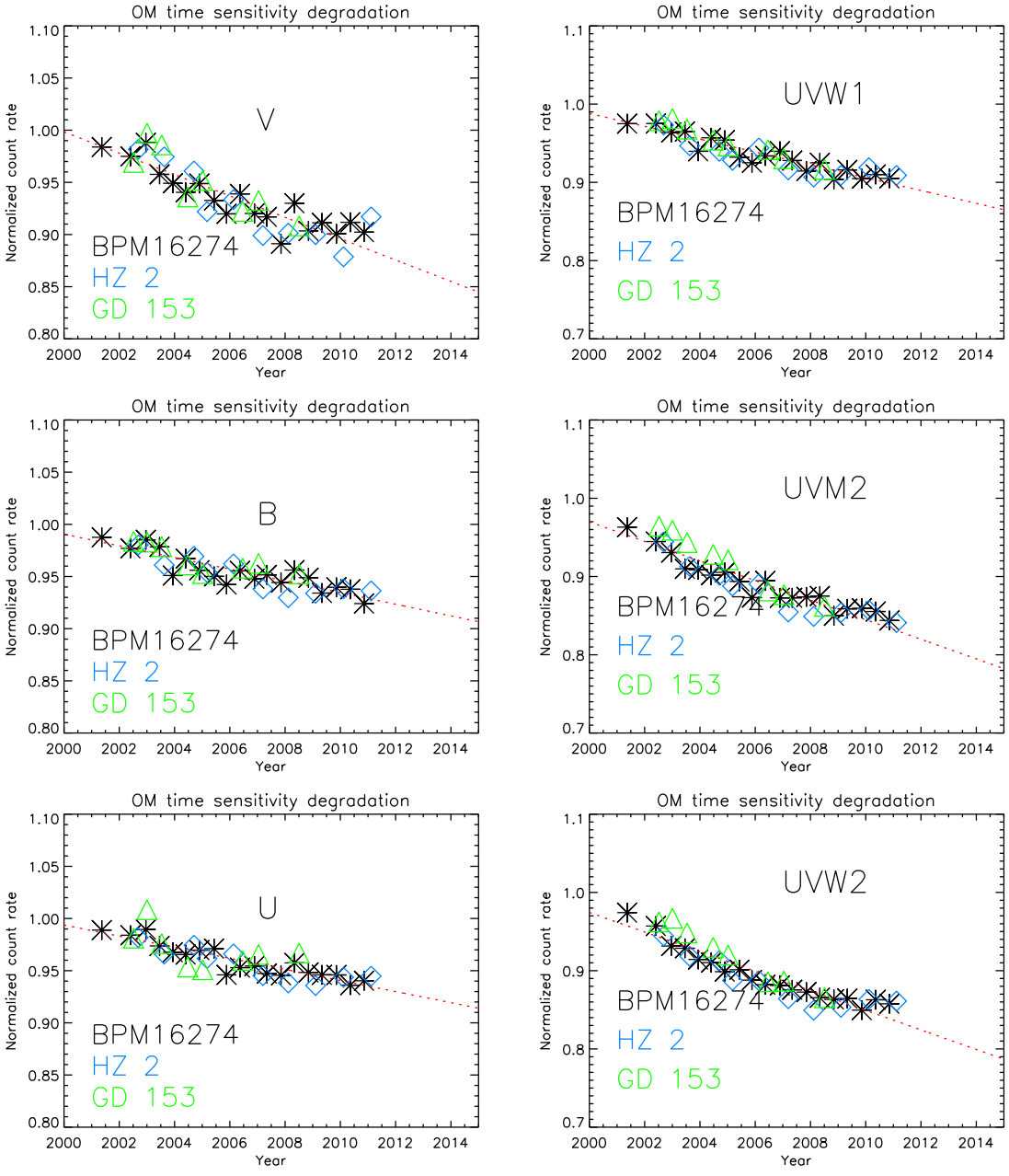

Figure 1: The normalized count rates of OM as a function of time for three white dwarfs, BPM16274 (black), Hz 2 (red), GD 153 (green)

5 Expected Updates

As the degradation trend changes in the future, then a new version of the correction coefficients will be implemented.

We use currently a linear approximation sufficiently accurate, but the structure of the CCF allows us to use a quadratic term in the correction if necessary.

Other solutions, e.g. an exponential one, would require a change of the structure of the CCF and therefore a corresponding change in the CAL

6 Test procedures

The testing of the new correction has two parts. First we compute the corrected counts of the observed stars using the new coefficients. In Table 2 we show the mean of the measured counts in all filters and the corresponding error (the standard deviations given as percentage). We can see the current correction and the proposed new one, as well as a quadratic approach.

In the second part of the test, we use the new CCF to process with SAS all observations of BPM 16274 to confirm the correctness of the CCF. The results of running SAS are presented in Table 3.

7 Summary of the test results

We can see in Table 2 that the errors in the application of the new correction are smaller than the ones we would obtain with the current SAS correction. We have tried also a quadratic approximation that gives errors similar to the new linear one. However, the quadratic solution predicts a change of slope in the degradation trend in the near future, which has no sense. This is the reason for selecting the linear one.

Table 3 shows that the new CCF works perfectly in SAS 11.

References

Table 2: Comparison of time sensitivity degradation correction coefficients

	new correction		**quadratic approach.**		**current SAS correction**	
filter	rate(c/s)	error(%)	rate(c/s)	error(%)	rate(c/s)	error(%)
BPM 16274						
UVW2	14.63	1.07	14.62	0.61	14.65	3.12
UVM2	30.31	1.14	30.29	1.00	30.35	3.58
UVW1	72.83	0.84	72.81	0.85	72.89	1.82
U	112.87	0.67	112.84	0.62	112.92	1.15
B	107.77	0.85	107.75	0.82	107.83	1.47
V	32.57	1.33	32.55	1.21	32.58	1.92
HZ 2						
UVW2	23.64	1.73	23.63	0.96	23.77	3.69
UVM2	48.21	1.40	48.20	0.96	48.50	3.51
UVW1	111.63	1.23	111.62	0.99	111.99	2.28
U	169.00	0.84	168.98	0.73	169.32	1.31
B	149.03	0.90	149.02	0.80	149.38	1.50
V	43.25	1.98	43.24	1.63	43.34	2.18
GD 153						
UVW2	82.92	1.33	83.08	0.86	82.01	1.09
UVM2	162.69	1.42	162.92	1.02	160.74	1.14
UVW1	329.58	0.70	329.84	0.52	327.53	0.79
U	420.47	1.64	420.75	1.57	418.88	1.86
B	284.22	0.77	284.37	0.74	282.91	1.25
V	70.64	1.64	70.74	1.51	70.31	1.52

Table 3: Processing all observations of BPM 16274 with SAS 11 and the new OM_PHOTTONAT_0005

filter	rate(c/s)	error(%)
UVW2	14.64	1.1
UVM2	30.34	1.2
UVW1	72.88	0.9
U	112.98	0.7
B	107.94	0.9
V	32.66	1.4